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The North Pickering Project

**COMMUNITY
DESIGN**
**people, dwellings, density
and community form
a preliminary study of
their inter-relationships**



Ministry of
Housing
Ontario

plantown
consultants limited

**BACKGROUND
PAPER 3**

This report was prepared as background material in the planning of North Pickering Planning Area and does not necessarily constitute a recommendation of the Ministry of Housing nor approval of the Government of Ontario.

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**BACKGROUND
PAPER**

**on:
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DESIGN**

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JUNE 1974

plantown
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1. INTRODUCTION

- 1.1 The way in which people sort themselves out as single individuals, couples, groups or families determines the generation of households. Since for every household there is, by definition, a dwelling unit, this sorting process establishes the inventory of dwelling required. In turn, the broad range of dwelling units, - rooms, flats, apartments, design houses, semi-detached houses, row houses, preferences and economics. Life styles and the life cycle shape are determined by the housing inventory. Figure 1, attempts to portray these relationships between people and their habitations.
- 1.2 The basic dwelling forms within which a broad range of architectural and siting ingenuity and innovation may occur, are the single and semi-detached house and the various multiple forms of housing. The multiples are fundamentally differentiated, by ground relationship alternatives and by intensity of land use, into three categories;
 - low density multiples which are on the ground,
 - moderate density multiples which are ground-related (walk-up)
 - higher density multiples which are ground-unrelated (elevator).
- Within all housing forms, conditions of tenure may vary between individual or mutual ownership circumstances (condominium, co-operative) and rental circumstances. Mixed tenure wherein the land is leased and the dwelling on it is owned, is also possible.
- 1.3 Beyond consideration of the individual dwelling, there is the larger residential environment. Its physical and social characteristics define the collectives of precinct, neighbourhood, community, town and region.
- 1.4 This analysis is concerned almost exclusively with the quantitative aspects of dwelling and the resultant community form. It attempts to indicate those quantitative aspects of interaction between people, dwellings, and land which strongly affect optional overall community forms.
- 1.5 The quantitative aspects of the relationship between people, dwellings, land and community forms do pose qualitative issues about the new community within which

significant choices must be made and significant trade-offs balanced. Decisions regarding the range of dwelling types, their occupants and their mix will pre-determine fundamental attributes of North Pickering as a place to live. Such decisions will determine:

- how dense the community will be and hence how much developed land, an expensive commodity in the Metropolitan area, it will require for a given population.
- how broad or narrow will be the range of life styles and living circumstances as determined by housing forms.
- how costly will be the housing economic determinants of developed residential properties and residential building forms.
- how the residential environment will be developed in terms of land planning and subdivision, property characteristics, street patterns and servicing systems.
- how will conditions of tenure vary within the community.
- how sensitive and innovative will be the matching of people, land and dwellings.

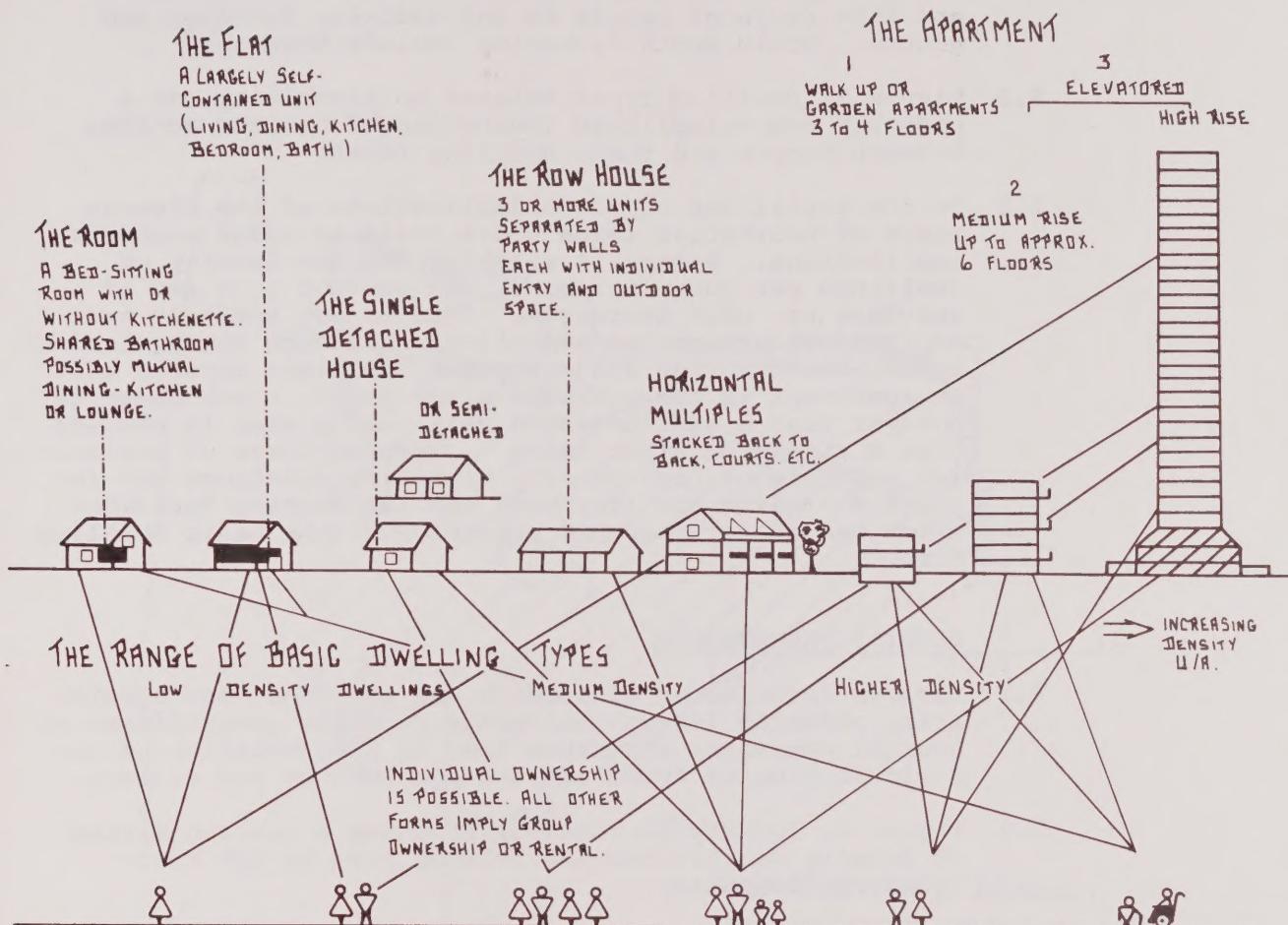
These are the basic issues within the planning concepts. Thus the rather arid quantitative characteristics outlined in this paper have a direct bearing on certain of the goals and objectives initially slated for the North Pickering Project. It may be useful to recall them as a prelude to this study:

- "to attract people with a range of values, life styles, age and stage of family development and socio-economic status".
- "to provide for a wide range and variety of residential development".
- "to control land prices within the Community in order to promote economic development and permit home ownership for the widest range of income levels and to influence property prices in the Toronto-Centred Region".
- "to expedite the provision of quality housing for people with a wide range of incomes, types of household and styles of living".

2. DWELLING TYPES RELATED TO LIVABILITY

- 2.1 The range of dwelling forms extends from the individual room to the apartment unit. To some considerable degree, housing

DWELLING TYPES RELATED TO LIVABILITY



THE INDIVIDUAL

THE SINGLE PERSON FREQUENTLY YOUNG OR ELDERLY

PAIRS

GROUPS

INDIVIDUAL OWNERSHIP IS POSSIBLE. ALL OTHER FORMS IMPLY GROUP OWNERSHIP OR RENTAL.

PARENTS WITH CHILDREN

THE BASIC NEED IS FOR GROUND RELATED CIRCUMSTANCES AND AUDIO-VISUAL PRIVACY

OLDER PEOPLE

THE ELDERLY

COPLES OR ALONE REQUIREMENTS RANGE FROM THE SELF-SUFFICIENT TO THE SENILE OR BED-RIDDEN

THE RANGE OF LIFE-CYCLE AND LIFE STYLE

Fig. 1

forms vary in their appropriateness to the life cycle and life style of people as individuals, families and groups. Would North Pickering include them all?

- 2.2 Figure 1, Dwelling Types Related to Livability, is a possibly over-simplified indication of optimum matches between people and their dwelling forms.
- 2.3 To the social and physical implications of the diverse range of habitation forms there could be added economic implications. Generally speaking, as the density of dwellings per acre increases, the cost of land and of services per unit decreases. This is not entirely true of the dwelling units themselves. Although for equivalent space, construction and equipment, it might be said that an apartment is cheaper than a row house, a row house is cheaper than a semi-detached unit, and a semi is cheaper than a single detached house - complex forms of horizontal multiple or high-density high-rise solutions may involve expensive architectural and landscaping decisions which can offset possible economies of the basic dwelling form.

3. DENSITY TERMINOLOGY

- 3.1 Various definitions of density are employed when considering planning issues that range from the generalities of overall community structure down to the specifics of individual housing types and their groupings and sitings.
- 3.2 Figure 2, Density Terminology, proposes a working system of density definitions and relates them to the North Pickering Community.
- 3.3 Density can be expressed either on a population basis, for example, in terms of people per acre, or on a dwelling basis in terms of units per acre. The transition from one expression to the other requires assumptions on the number of persons per household either as an average or as related to the differences in occupancy of various housing types.
- 3.4 As an example of the various definitions of density illustrated in Figure 2, Density Terminology, a population of 200,000 persons with 40% of dwellings being singles and semis, 25% being middle density housing (on the ground) and 35% being higher density housing (ground related and unrelated) with a resultant average household size of 3.34 persons, would probably produce the following density configurations:

DENSITY TERMINOLOGY

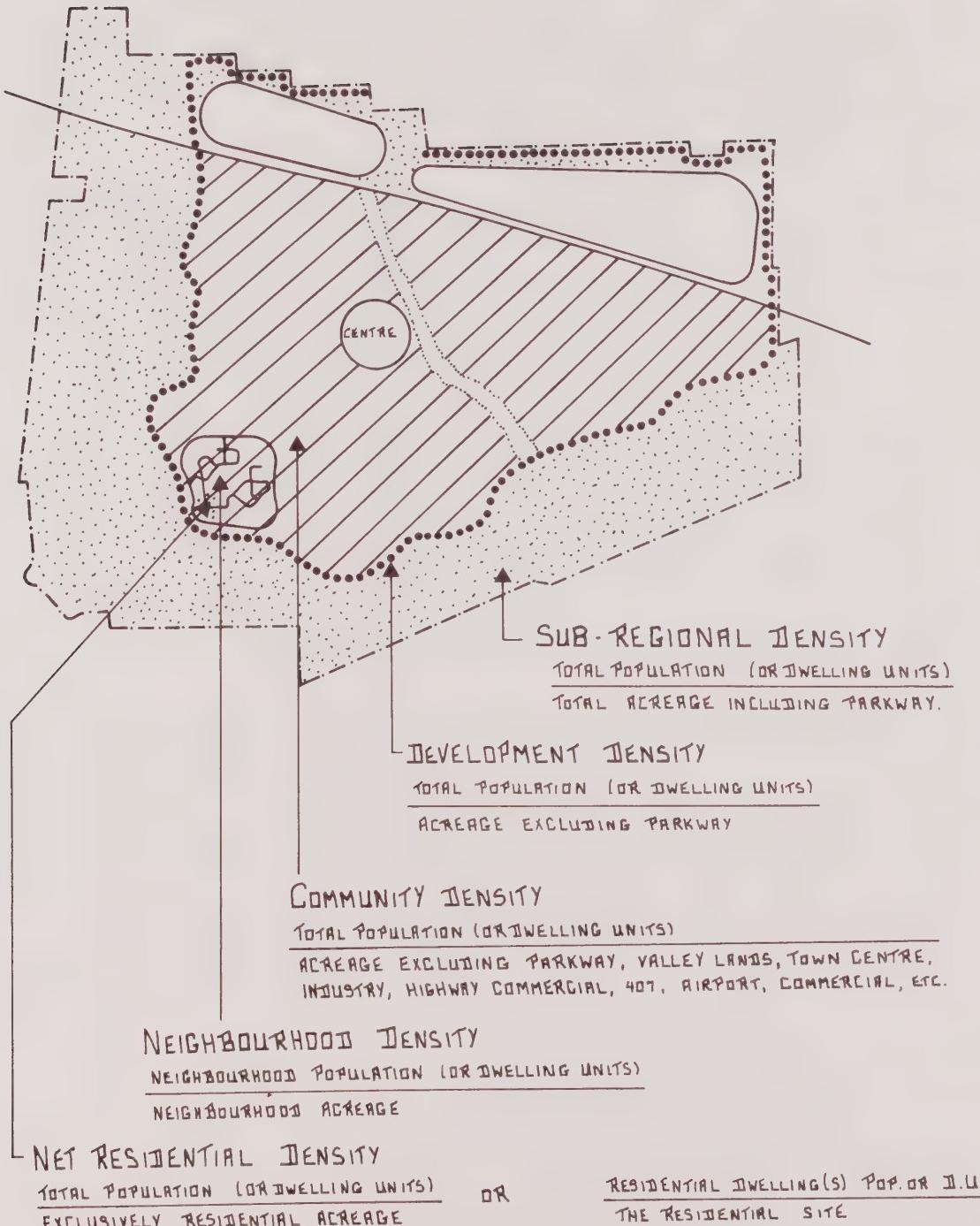


Fig. 2

-Sub-Regional Density - <u>total population</u>	$\frac{**\ 200,000}{25,000}$	= 8 persons/a.
total acreage including parkway		= 2.4 units/a.
-Development Density - <u>total population</u>	$= \frac{200,000}{15,765}$	= 13 persons/a.
acreage excluding parkway		= 4.0 units/a.
-Community Density - <u>total population</u>	$= \frac{200,000}{7,765}$	= 26 persons/a.
acreage excluding parkway, valley lands, large special recreation areas, town centre, industry, highway & airport commercial.		= 7.7 units/a.
-Neighbourhood Density - <u>neighbourhood population</u>	$= \frac{5,000}{172}$	= 29 persons/a.
neighbourhood area in acres		= 8.1 units/a.
*-Net Residential Density - <u>total population</u>	$= \frac{200,000}{4,500}$	= 45 person/a.
residential area only		= 13.5 units/a.

- * - the term Net Residential Density can apply to any unit from the total community down to a specific housing group. i.e.
 - net residential density on a community basis as above 45 p/a.
 - or net residential density on a housing group basis for town houses 15 u/a or 18 u/a.
 - or for apartments 45 u/a.

This proviso is that only residential land enters into the calculation.

**- the 200,000 population figure is used for illustrative purposes only.

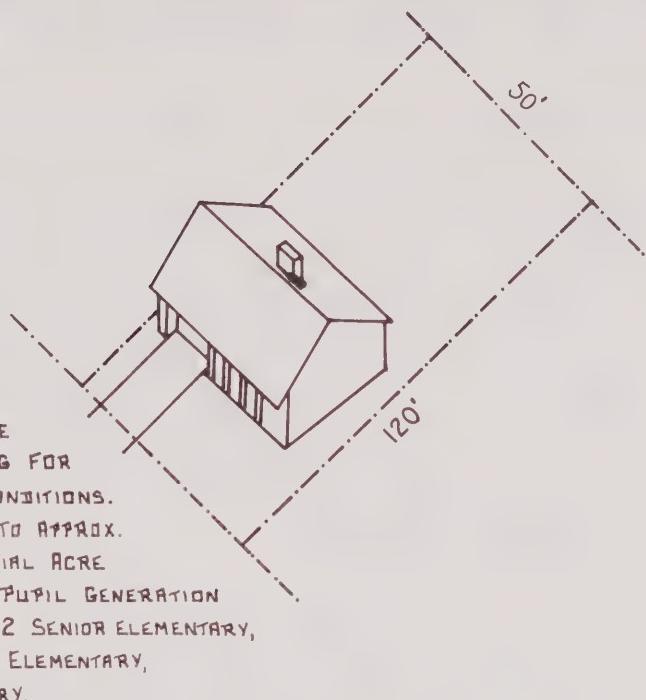
4. DWELLING TYPES RELATED TO DENSITY & SITE UTILIZATION

- 4.1 It is useful in analysing housing characteristics to categorize dwelling types under density configurations.
- low density housing: -including both the single family house and the semi-detached house.

DWELLING TYPES RELATED TO DENSITY AND SITE UTILIZATION

LOW DENSITY HOUSING

THE SINGLE FAMILY HOUSE



DENSITY - A COMMON PROPERTY SIZE
IS 50' x 120' = 6000 S.F. ALLOWING FOR
SUBDIVISION LAYOUT AND SITE CONDITIONS.
IT DENSITY NORMALLY WORKS OUT TO APPROX.
6 DWELLINGS PER NET RESIDENTIAL ACRE
3.8 PERSONS PER DWELLING; PUPIL GENERATION
0.5 K-6, 0.2 SENIOR ELEMENTARY,
0.2 SEPARATE ELEMENTARY,
0.5 SECONDARY.

ADVANTAGES - THE MOST PREFERRED DWELLING FORM - INDIVIDUAL PROPERTY OWNERSHIP.
INDEPENDENCE, PRIVACY, INVESTMENT.
PARTICULARLY SUITABLE TO FAMILIES WITH CHILDREN.
CAR ENCLOSURE AND DRIVEWAY GIVES 200% OFF STREET PARKING CAPACITY

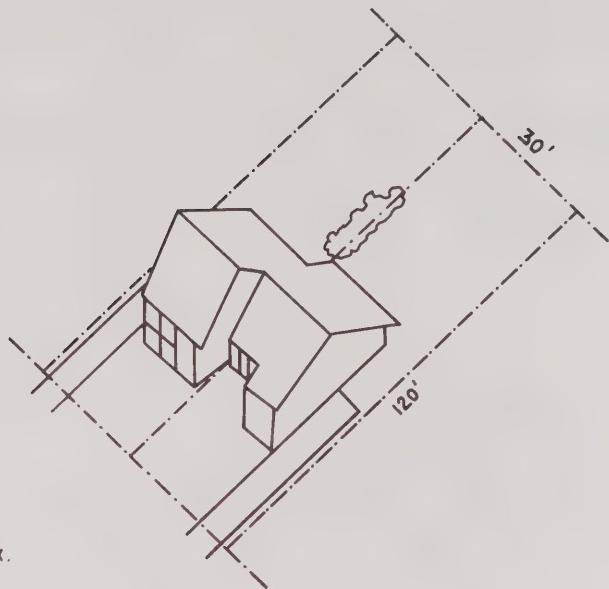
DISADVANTAGES - THE MOST EXPENSIVE HOUSING SOLUTION IN TERMS OF CONSTRUCTION COSTS,
AND SERVICED LAND. CURRENT COSTS OF BUILDING, LAND AND MONEY COMBINED WITH INCREASED
MUNICIPAL AND OTHER STANDARDS HAVE PLACED THE SINGLE FAMILY HOUSE BEYOND THE MAJORITY
OF PEOPLE.

POTENTIAL INNOVATIONS - TO RE-ACCESS THE CONTINUING VIABILITY OF THE SMALL SINGLE FAMILY
HOUSE AND LOT AS A MODERATE DENSITY HOUSING FORM. FOR EXAMPLE LOTS 25' x 100' IN NEW
CLUSTER CONFIGURATIONS COULD GIVE DENSITIES OF 15 U/A.
TO EXPLORE A RANGE OF SITE PLANNING TECHNIQUES AND HOUSE DESIGNS INVOLVING CLUSTER
DEVELOPMENTS, ZERO LOT LINES AND OTHER CONFIGURATIONS TO ACHIEVE GROUPINGS OF
SINGLE FAMILY HOUSES AT SIGNIFICANT DENSITIES.

DWELLING TYPES RELATED TO DENSITY AND SITE UTILIZATION

LOW DENSITY HOUSING

THE SEMI-DETACHED HOUSE



DENSITY - A COMMON PROPERTY SIZE

IS $30' \times 120' = 3600$ S.F. ALLOWING FOR
SUBDIVISION LAYOUT AND SITE CONDITIONS
ITS DENSITY NORMALLY WORKS OUT TO APPROX.
10 DWELLINGS PER NET RESIDENTIAL ACRE
4.0 PERSONS PER DWELLING; PUPIL GENERATION;
0.6 K-6, 0.2 SENIOR ELEMENTARY
0.3 SEPARATE ELEMENTARY
0.4 SECONDARY

ADVANTAGES - THE SECOND CHOICE FOR MOST AFTER THE SINGLE FAMILY HOUSE, FOR THE SAME REASONS OF PROPERTY OWNERSHIP, INDEPENDENCE, PRIVACY AND INVESTMENT.

QUITE SUITABLE TO FAMILIES WITH CHILDREN.

DRIVEWAY USUALLY PROVIDES 200% OFF STREET PARKING CAPACITY

A COST SAVING OF APPROX. \$500 UNDER A SAME SIZE¹ SINGLE FAMILY HOUSE

DISADVANTAGES - SOME MODERATE PROBLEMS OF INTERNAL ACOUSTICAL PRIVACY AND EXTERNAL ACOUSTICAL AND VISUAL PRIVACY.

POTENTIAL INNOVATIONS - AS WITH SINGLE FAMILY HOUSE THE SMALL SEMI HOUSE AND LOT SHOULD BE RE-APPRAISED

NEW SITE PLANNING TECHNIQUES

NEW WAYS OF HANDLING THE PARKED CAR IN SEMI-DETACHED SITING.

DWELLING TYPES RELATED TO DENSITY AND SITE UTILIZATION

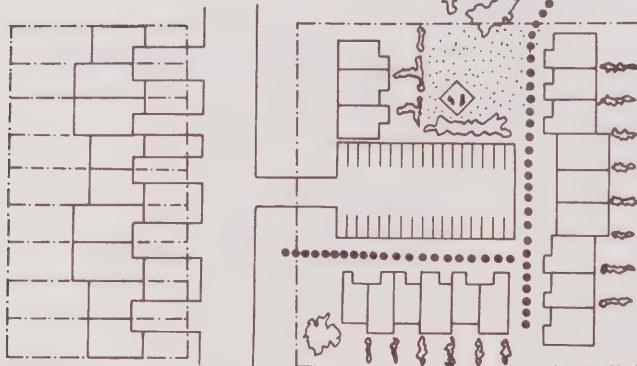
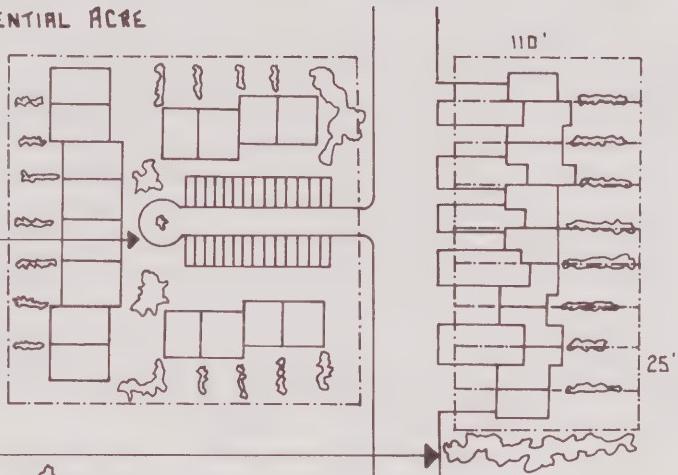
MIDDLE DENSITY HOUSING

ON-THE-GROUND MULTIPLE FORMS - AS FOR EXAMPLE ROW HOUSES, COURTYARD HOUSES, ATRIUM HOUSES ETC.

DENSITY - 15 DWELLINGS PER NET RESIDENTIAL ACRE

THIS DENSITY PERMITS A PLEASANT TYPE OF ROW HOUSING 24 TO 25 FT. WIDE, WITH 150% ON GRADE PARKING AND GENEROUS PRIVATE GARDENS. SMALLER DWELLINGS AND GARDENS PERMITS COMMON GREENS

15 D/A. WILL PERMIT TERRACE HOUSING FOR SALE WITH 200% OFF STREET PARKING AND 2800 S.F. LOTS.



DENSITY - 18 DWELLINGS PER NET RESIDENTIAL ACRE

PERMITS ROW HOUSES GENERALLY 20 FEET IN WIDTH, WITH 150% ON GRADE PARKING AND ADEQUATE PRIVATE GARDENS.

COMMON SPACE FOR MUTUAL USE IS FEASIBLE.

18 D/A. WILL PERMIT TERRACE HOUSING FOR SALE WITH 200% OFF STREET PARKING. LOTS APPROX. 20' TO 22' AND 105' DEEP GIVING 2400 S.F. IN AREA.

ROW HOUSES HAVE GENERALLY 3-8 PERSONS PER DWELLING UNIT OR FROM 57 TO 69 P/A

PUPIL GENERATION - K-6 0.6; SENIOR ELEM. 0.2; SEP. SCHOOL 0.2; SECONDARY 0.3.

THERE ARE MANY OTHER "ON THE GROUND" MULTIPLE FORMS. BUT WITHOUT RESORTING TO STACKED UNITS (SEE HIGHER DENSITY) THE USE INTENSITY IS ABOUT THE SAME. ROW HOUSE CONSTRUCTION COSTS MAY BE \$500 BELOW SIMILAR SEMI ACCOMMODATION. LANDSCAPING AND SCREENING IS PROBABLY MORE EXPENSIVE THAN FOR SEMIS.

ADVANTAGES - THE MULTIPLE HOUSING FORM THAT COMES CLOSEST TO THE CHARACTERISTICS OF THE MARKET-PREFERRED SINGLE AND SEMI-DETACHED HOUSE. ON-THE-GROUND MULTIPLE HOUSING HAS DEFINATE ADVANTAGES IN TERMS OF: PRIVATE OUTDOOR SPACE, REDUCTION OF MUTUALLY USED SPACES WHICH IS HELPFUL TO OWNERSHIP AND MAINTENANCE IMPLICATIONS.

DISADVANTAGES - BUILDING COST SAVINGS COMPARED TO SINGLES AND SEMIS MAY BE MORE THAN OFFSET BY LANDSCAPING AND SCREENING NECESSITIES IN SITE DEVELOPMENT.

POTENTIAL INNOVATIONS - WILL BE FOUND LARGELY IN THE DEVELOPMENT OF NEW ARCHITECTURAL SOLUTIONS TO THE BUILDING FORMS.

DWELLING TYPES RELATED TO DENSITY AND SITE UTILIZATION

HIGHER DENSITY HOUSING

OFF THE GROUND) MULTIPLE FORMS WHICH MAY BE EITHER GROUND RELATED (WALK-UP SOLUTIONS) OR GROUND UNRELATED (ELEVATOR SOLUTIONS)

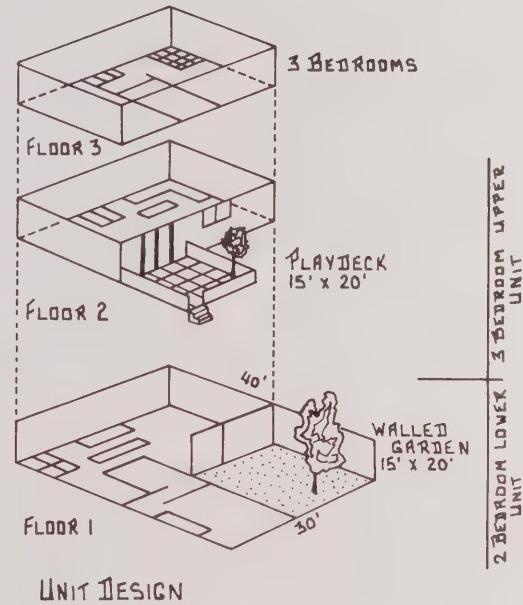
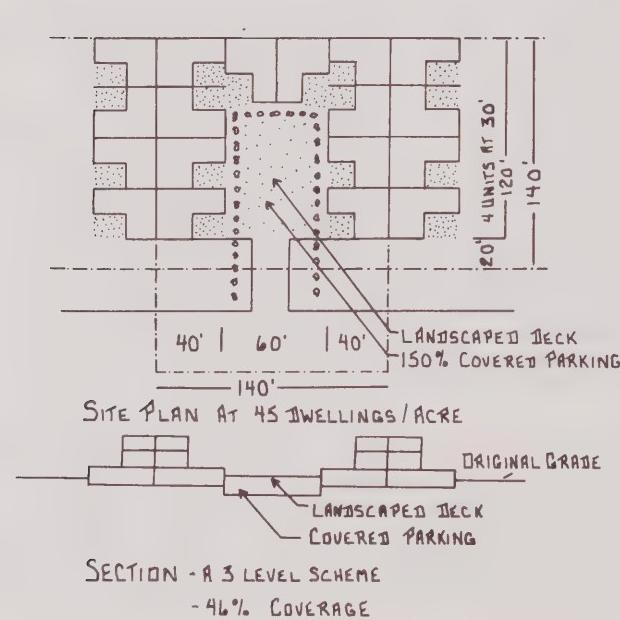
DENSITY- 40 to 45 DWELLINGS PER NET RESIDENTIAL ACRE

THE GROUND RELATED, OR WALK-UP SOLUTIONS HAVE MAXIMUM DENSITY LIMITATIONS IMPOSED BY THE COMBINED EFFECT OF ACCEPTABLE SITE COVERAGE IDEAS AND STAIR CLIMBING SITUATIONS. INGENIOUS BUILDING CROSS SECTIONS AND MANIPULATION OF EXTERIOR GRADES WILL HELP AS WILL SIMILAR INGENUITY IN THE LANDSCAPE. THE GROUND-RELATED UNIT DENSITIES WORKS OUT TO FORM 40 TO 45 DU./A AS A MAXIMUM. ON THESE DENSITIES CAN BE SUPERIMPOSED ADDITIONAL UNITS BY RISING ABOVE THE GROUND RELATED SYSTEM OR BY INSERTING INTO THE SITE HIGHER APARTMENT TYPE BUILDINGS. PARKING AT THESE DENSITIES MUST BE OTHER THAN ON GRADE.

FROM 2.5 TO 3.0 PERSONS PER DWELLING; PUPIL GENERATION: K-6 0.2; SENIOR ELEMENTARY 0.05
100 TO 135 P/A SEPARATE SCHOOLS 0.08; SECONDARY 0.1

THESE HIGHER-DENSITY LOW PROFILE SCHEMES PROVIDE CHALLENGING INNOVATIVE DESIGN OPPORTUNITIES.

3 SKETCHES OF HIGHER DENSITY HOUSING:



ADVANTAGES - ECONOMICS OF DWELLING UNIT COSTS AND SITE UTILIZATION AND SERVICING MAY BE OF IMPORTANCE.

DISADVANTAGES - ASPECTS OF TERRITORIALITY AND OF VISUAL AND ACoustICAL PRIVACY ARE COMPLICATED AS DENSITY INCREASES. CONTACT WITH PRIVATE OUTDOOR GROUNDS IS MINIMIZED.

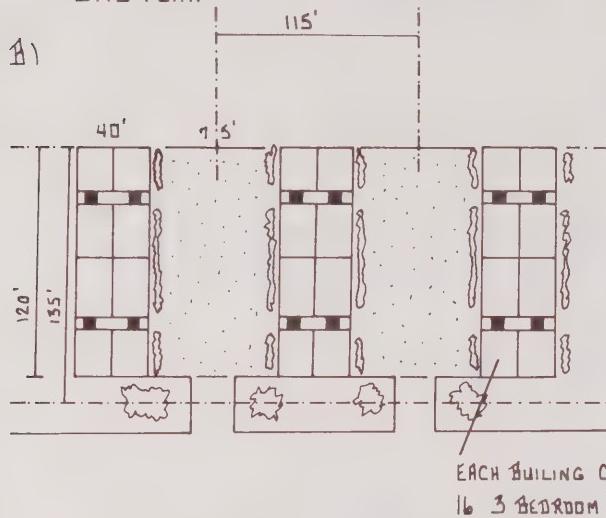
POTENTIAL INNOVATIONS - PROBABLY THE MOST NECESSARY INNOVATIONS IN HIGHER DENSITY HOUSING HAVE TO DO WITH FAMILY LIVABILITY PROBLEMS.

1 DWELLING TYPES RELATED TO DENSITY AND SITE UTILIZATION

HIGHER DENSITY HOUSING (CONTINUED)

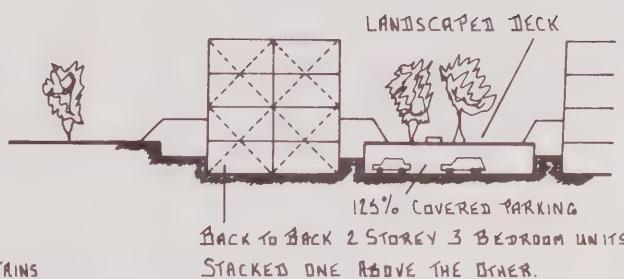
DENSITIES OF 40 TO 45 DWELLINGS PER NET RESIDENTIAL ACRE

SITE PLAN

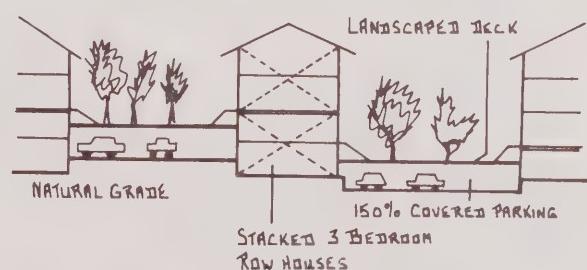
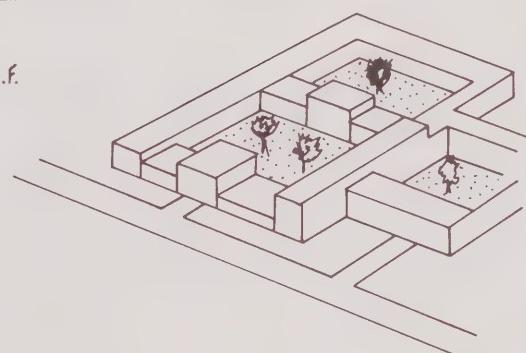
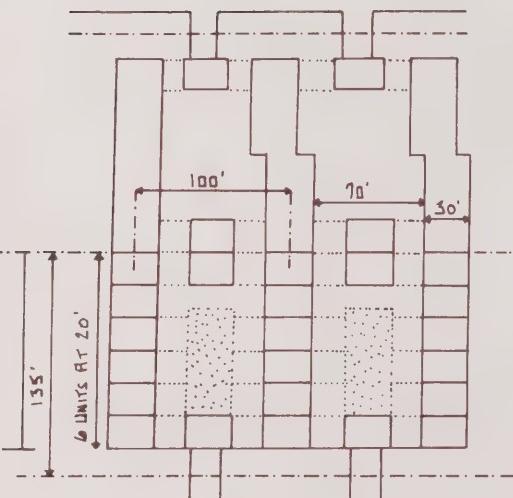


A 4 LEVEL SCHEME; 30% COVERAGE
45 UNITS PER ACRE; EACH UNIT 3 BEDROOMS, 1000 S.F.

SECTION



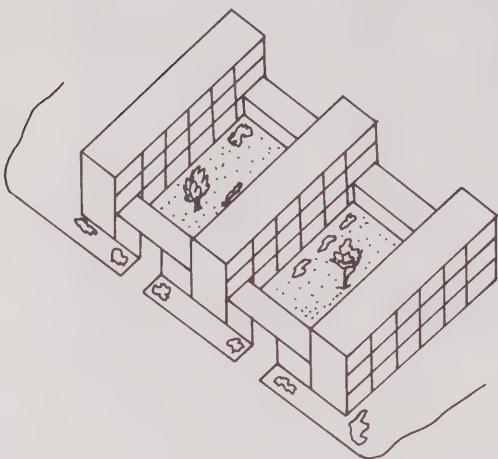
C1



A 4 LEVEL COURTYARD SCHEME AT 45 UNITS PER ACRE; 35% COVERAGE
EACH UNIT HAS 3 BEDROOMS AND AN AREA OF 1200 S.F.; EACH HAS A PRIVATE GARDEN 20' X 25'
PLUS A SHARE OF A SMALL COMMON GREEN.

DWELLING TYPES RELATED TO DENSITY AND SITE UTILIZATION AN EXAMINATION OF HIGHER DENSITY HOUSING IN THE RANGE OF 40 TO 45 DWELLINGS / NET ACRE

INDICATING THE EFFECT OF GROUND-RELATED AND GROUND-UNRELATED UNITS
IN VARIOUS PROPORTIONS.



EXAMPLE 1:

GROUND-RELATED UNITS 100%

GROUND-UNRELATED UNITS 0%

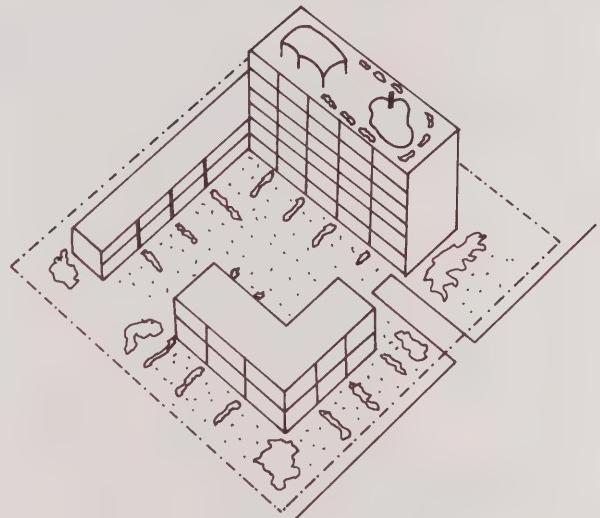
3 LEVEL SCHEME AT ABOUT 45% COVERAGE OR 4 LEVEL SCHEMES WITH 30% COVERAGE BOTH WITH 125%
TO 150% PARKING UNDER COVER WILL GIVE DENSITIES
OF ABOUT 45 UNITS / NET RESIDENTIAL ACRE MAXIMUM.

EXAMPLE 2:

GROUND-RELATED UNITS 50%

GROUND-UNRELATED UNITS 50%

2 LEVEL (TERRACE HOUSING) AT 30% COVERAGE
IN COMBINATION WITH A 6 STOREY BUILDING
(2 LEVELS GRD.-RELATED, 4 LEVELS ABOVE)
AND 125% TO 150% COVERED PARKING.



EXAMPLE 3:

GROUND-RELATED UNITS 0%

GROUND-UNRELATED UNITS 100%

AN 8 STOREY BUILDING WITH 15% COVERAGE
AND ON-GRADE 125% PARKING GIVES A DENSITY
OF 45 U./ACRE.

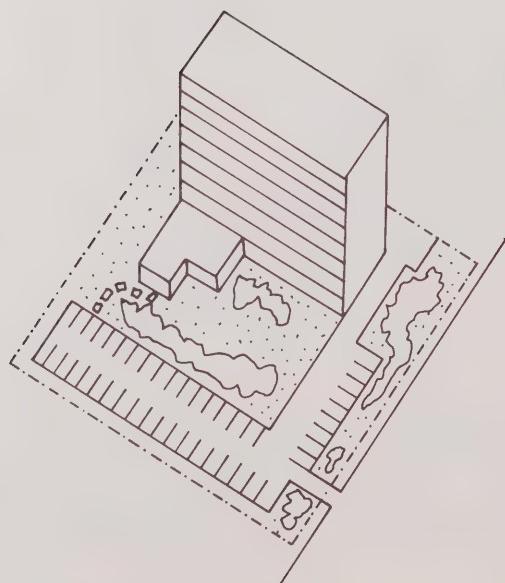


Fig. 8

- middle density housing: -including all on-the-ground multiple housing forms as for example, row houses, court-yard and atrium houses, back-to-back houses, quadrafoils, etc.
- high density housing: -including all off-the-ground multiple forms. These may be either ground-related (walk-up) or ground-unrelated (elevator solutions). The most usual type is the apartment.

- 4.2 Figure 3 and 4, explore some aspects of low density (singles, semis) housing.

Figure 5, indicates certain characteristics of middle density solutions (at 15 and 18 dwellings/net residential area).

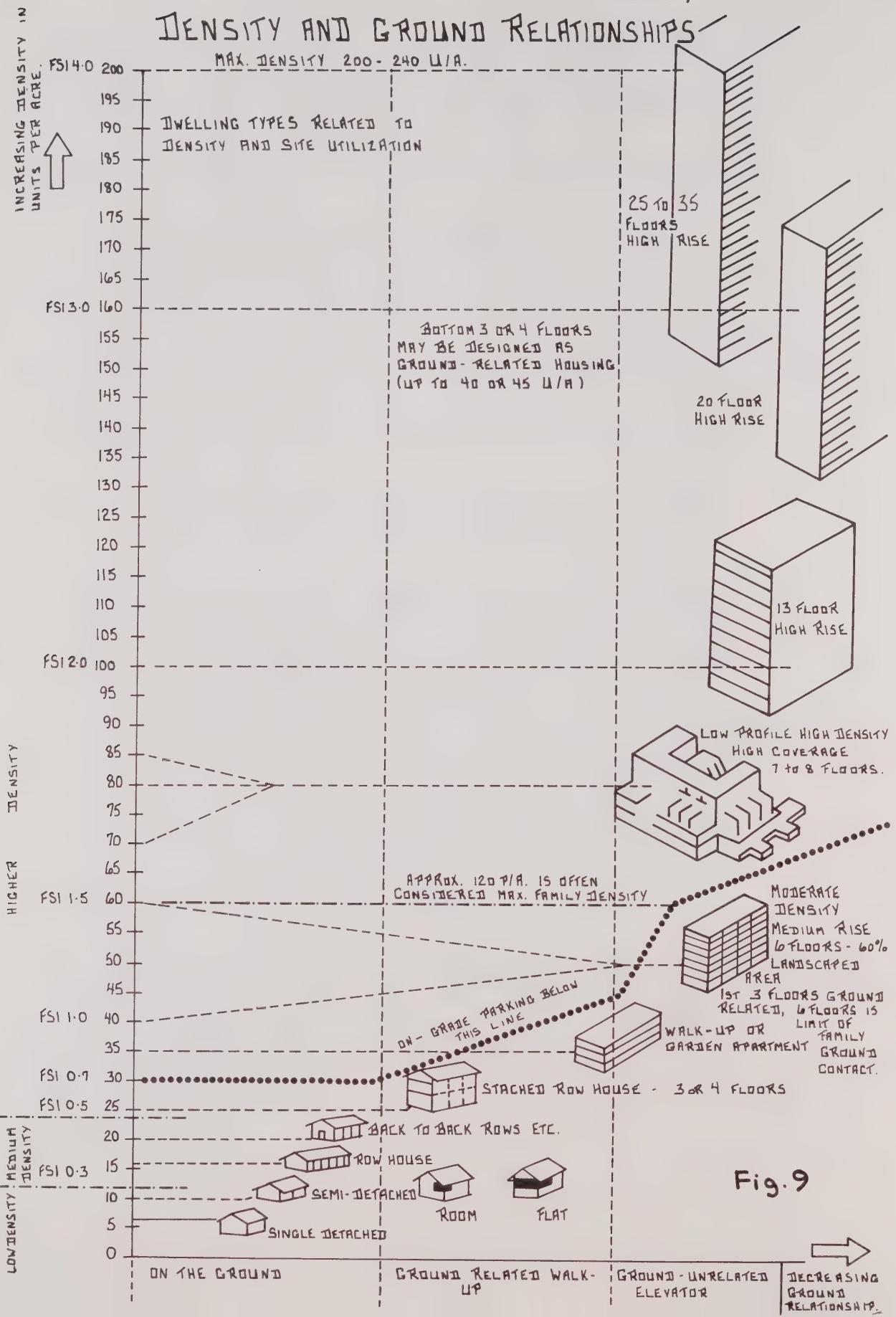
Figure 6 and 7, show how higher density housing of a ground-related or walk-up nature can be accomplished at densities up to 45 units/net residential acre.

- 4.3 Figure 8, An Examination of Higher Density Housing, indicates how for a given density (in this case 45 units/net residential acre), varying the mixture of ground-related (walk-up) and ground-unrelated (elevated) buildings will permit of increased open space (or decreased building coverage) as the ground-unrelated units become more dominant in the scheme. Higher densities can be achieved but would necessitate elevator type buildings above or alongside what might be termed the ground-related stratum of units. The current interest in low profile high density schemes require such superimpositions on the ground related stratum of units. Seven or eight storey low profile high density schemes can achieve something like 75 to 90 units/acre (probably from FSI 1 to FSI 2). Above this figure, European and North American experiences indicate serious problems of open space, acoustical and visual privacy and claustrophobic building massing.

- 4.4 Figure 9, of the series on Dwelling Types Related to Density and Site Utilization is titled - The Interaction of Housing Forms, Density and Ground Relationships.*

This diagram attempts to relate the entire range of housing forms from the room to the high-density apartment to increasing density, shown vertically, and to decreasing ground relationships from left to right horizontally.

THE INTERACTION OF ¹⁴ HOUSING FORMS, DENSITY AND GROUND RELATIONSHIPS



The basic net residential density of various housing forms is indicated in units/net residential acre and is also expressed as a floor space index (FSI). ** The three basic ground relationships which constitute a primary social and physical determinant of housing forms are on the ground; ground-related; and ground-unrelated. An indication is given by figurines of the appropriateness of the form to individual, group, and family circumstances. Examination of the diagram will disclose at what point or residential development intensity it is necessary to move parking below buildings or within landscaped decks.

- * Based on material prepared by James A. Murray, as a consultant study entitled 'Innovation in Housing for the Ontario Advisory Task Force on Housing Policy'.
- ** FSI relates floor area to site area. For example, a Floor Space Index of 1.5 means that on one acre of land (43,560 s.f.) 65,340 s.f. of floor space (usually exclusive of parking and mechanical rooms) or approximately 65 suites may be built. The index is frequently used in planning and development.

5. EFFECTS OF VARIOUS DWELLING TYPES ON RESIDENTIAL DENSITY AND SITE UTILIZATION

- 5.1 Various dwelling types ranging from the single family house to high-rise apartments exhibit particular characteristics of dwelling occupancy in terms of persons/unit and site utilization in terms of site area/dwelling unit and consequently of dwelling units/acre. Thus varying the mix of dwelling types fundamentally predetermines residential density configurations in terms of:
 - the density of persons per household:
 - which for a given population determines the number of dwelling units.
 - the density of persons per net residential acre:
 - which for a given population determines the total net residential acreage required in the community.
 - the density of dwelling units per net residential acre:
 - which also for a given population determines the required residential acreage.
- 5.2 Changes in residential dwelling mixes and consequent changes in residential density affect not only the micro-environments of precinct and neighbourhood, they similarly affect the macro-environment of total community form. Such changes on the larger scale may produce a diffuse community of gentle densities or a compact residential environment perhaps twice as dense.

- 5.3 Of course, in addition to these quantitative aspects of dwelling mix and urban structure, there are qualitative issues inherent in the range of basic housing forms. Such diverse considerations arise as matching dwellings to people whether as individuals, pairs, communes, married couples with or without children of various ages or the elderly.

Matters of life styles, property ownership or rental and shelter economics, are inherent in various forms in various dwelling types as are matters of individuality and communalism, of privacy and exposure. These issues which are the roots of housing and the residential environment are largely ignored in this review which concentrates on the quantitative consequences.

- 5.4 The following table indicates how both the average household and the density of residential development are affected by changing the mix of dwelling types. The average household size determines the number of dwellings required. The residential density, whether expressed in terms of persons or dwelling units/net residential acre, determines the residential acreage of the total community. Persons/dwelling unit have been somewhat reduced from current 1973 experience (see table 5.5 above).

- 5.5 The following explanations and observations which arise from a study of the table are offered:

A. examples 1 to 5 have a complete range of dwelling types.

examples 6 to 10 have no singles or semis.

B. example 1 has a mix of 40% in singles and semis, 25% in row housing and 35% in apartments. This is a conventional mix (like Erin Mills, Columbia, etc.) and produces a density of 45 persons/net residential acre.

C. example 2 reduced the singles and semis to half those in the conventional mix of example 1. The density rises only to 54 p/a.

D. example 3 uses the same 20% of singles and semis as in example 2 but increases the density of multiple middles to 18 u/a and increases the multiple higher to 150 u/a. (approx. 18 floor apts; See Figure 9).

The average density rises only to 66 p/a. It appears to be impossible to achieve a residential form at twice the conventional density

of example 1. (i.e. 90 p/a instead of 45) with 20% of units in singles and semis which occupy 53.5% of the site for 24% of the population.

E. example 4

still retaining 20% of singles and semis, 80% of the units are in higher density multiples with no middle density units. In this case, the residential density rises to approximately double the conventional example 1. This is only achieved by an unmanageable distortion wherein 80% of the units are on 17% of the site and 20% of the units (singles and semis) occupy 80% of the site.

F. example 5

by dropping the singles and semis to only 10% of the units and by using 18 u/a for middle density housing plus 150 u/acre for high density housing (53% of all units), the doubly dense residential form is achieved (87 p/a). Whether 45% of the population would want to live in high-rise circumstances is questionable. 150 units/acre is beyond low profile high density housing forms (see Figure 9).

G. examples

6, 7, 8
& 9

illustrates that even when all singles and semis are omitted, significantly compact densities as compared to the normal mix (example 1) are not achieved with middle multiples at 15 units/acre and higher density multiples at 40 units/acre.

H. example 10

this compact residential structure is approximately twice as dense as the more orthodox mix of scheme 1. (i.e. 89 p/a as compared to 45 p/a.)

For a community of 200,000 persons, the 4,500 residential acres required by the conventional mix of all housing types would be reduced by some 2,250 acres.

This would be accomplished by a drastic reduction in the diversity of dwelling types. In particular, the singles and semis which are the preferred forms would disappear. Individual property ownership would be seriously curtailed

**EFFECTS OF VARIOUS MIXES OF DWELLING TYPES
ON RESIDENTIAL LAND UTILIZATION & DENSITY**

EXAMP.	DWELLING TYPE	MIX	POPULATION		LAND UTILIZATION		
			PERSONS / D.U.	OCCUPANTS	DU / NET. RES. AC.	AREA / D.U.	SITE AREA
1	SINGLES	20	3.8	76	6	7200	144,000
	SE/US.	20	4.0	80	10	4200	84,000
	MULTIPLE MIDDLE	25	3.8	95	15	2800	70,000
	MULTIPLE HIGHER	35	2.5	87	40	1100	38,000
	TOTALS	100 D.U.	HOUSING	338	PERSONS	ON	7.5 NET. RES.
	STATISTICS	3.38	P/HH. ;	45 P/A. ;	13.4	D.U./A.	
2	SINGLES	10	3.8	38	6	7200	72,000
	SE/US	10	4.0	40	10	4200	42,000
	MULTIPLE MIDDLE	35	3.8	133	15	2800	98,000
	MULTIPLE HIGHER	45	2.5	113	40	1100	49,500
	TOTALS	100 D.U.	HOUSING	324	PERSONS	ON	6.0 NET. RES. A.
	STATISTICS	3.24	P/HH. ;	54 P/A. ;	16.7	D.U./A.	
3	SINGLES	10	3.8	38	6	7200	72,000 } 53.5
	SE/US	10	4.0	40	10	4200	42,000 }
	MULTIPLE MIDDLE	35	3.8	133	18	2400	84,000
	MULTIPLE HIGHER	45	2.5	113	150	290	16,000
	TOTALS	100 D.U.	HOUSING	324	PERSONS	ON	4.9 NET. RES. A.
	STATISTICS	3.24	P/HH ;	66 P/A. ;	20.5	D.U./A	
4	SINGLES	10	3.8	38 } 28%	6	7200	72,000 } 83
	SE/US	10	4.0	40 } 20	10	4200	42,000 }
	MULTIPLE MIDDLE	0	0.0	0	0	0	0
	MULTIPLE HIGHER	80	2.5	200	150	290	23,200
	TOTALS	100 D.U.	HOUSING	278	PERSONS	ON	3.14 NET. RES. A.
	STATISTICS	2.78	P/HH ;	89 P/A. ;	32	D.U./A	
5	SINGLES	5	3.8	19 } 12.5%	6	7200	36,000 } 36
	SE/US	5	4.0	20 } 14	10	4200	21,000 }
	MULTIPLE MIDDLE	35	3.8	134	18	2400	84,000
	MULTIPLE HIGHER	55	2.5	138	150	290	16,000
	TOTALS	100 D.U.	HOUSING	311	PERSONS	ON	3.6 NET RES. A.
	STATISTICS	3.11	P/HH. ;	87 P/A. ;	28	D.U./A.	

X/A/P.	DWELLING TYPE	MIX	POPULATION		LAND UTILIZATION		
			PERSONS/D.U.	OCCUPANTS	D.U./NET RES. AC.	AREA / D.U.	SITE AREA
6	MULTIPLE MIDDLE	70	3.8	266	15	2800	196,000
	MULTIPLE HIGHER	* 30	3.0	90	40	1100	33,000
	TOTALS	100 D.U.	HOUSING	356	PERSONS	ON	5.25 NET. RES. AC.
	STATISTICS	3.56	P/HH ;	68 P/A ;	19	D.U./A	
7	MULTIPLE MIDDLE	60	3.8	228	15	2800	168,000
	MULTIPLE HIGHER	40	3.0	120	40	1100	44,000
	TOTALS	100 D.U.	HOUSING	348	PERSONS	ON	4.85 NET. RES. AC.
	STATISTICS	3.48	P/HH ;	72 P/A ;	20.5	D.U./A	
8	MULTIPLE MIDDLE	50	3.8	190	15	2800	140,000
	MULTIPLE HIGHER	50	3.0	150	40	1100	55,000
	TOTALS	100 D.U.	HOUSING	340	PERSONS	ON	4.5 NET. RES. AC.
	STATISTICS	3.4	P/HH ;	76 P/A. ;	22.5	D.U./A	
9	MULTIPLE MIDDLE	40	3.8	152	15	2800	112,000
	MULTIPLE HIGHER	60	3.0	180	40	1100	66,000
	TOTALS	100 D.U.	HOUSING	332	PERSONS	ON	4.06 NET. RES. AC.
	STATISTICS	3.32	P/HH ;	82 P/A ;	24.8	D.U./A	
10	MULTIPLE MIDDLE	50	3.8	190	* 18	2400	120,000
	MULTIPLE HIGHER	50	3.0	150	* 45	970	48,750
	TOTALS	100 D.U.	HOUSING	340	PERSONS	ON	3.85 NET. RES. AC.
	STATISTICS	3.4	P/HH ;	89 P/A ;	26.5	D.U./A	

presumably to sale town houses but condominium or other forms of group ownership might well increase. Additional green open space of some 2,250 acres could be added to the community structure. Whether this is required or useful over and above a total green space of some 11,000 acres (Parkway Belt and large scale recreation in CNR zone) giving 66 acres/1,000 population is surely questionable when the trade-off is a reduction in dwelling diversity.

Alternatively, the denser configuration would permit a total population of some 250,000 persons on the same area of site, leaving the Parkway Belt, etc. intact. (Although the net density is doubled, the overall town population is not doubled because the additional population must be with additional schools, shops, jobs, roads and so on.) It is unlikely that an urban form of that size could be justified at such high density and with such limitations on dwelling types and life styles.

5.6 In conclusion, some general comments can be noted regarding the affects of various mixes of dwelling types on residential land utilization and density.

- A. If a complete range of dwelling types is desirable in the new community at overall densities which are neither profligate of valuable land nor cramping the physical and social attributes of the residential environment and if serviced land economics have a bearing on the problem, then mixing something of the order of 40% in single and semi-detached dwelling forms and 60% in multiple housing of varied types and density are probably required.
- B. An attempt to build a truly compact residential environment over the entire community at, for example, double normal density, can only be based upon elimination almost entirely of single and semi-detached housing forms and by utilizing a significant proportion of high density building. It is questionable if this constitutes a promising physical or social approach. However, limited areas of an intensely urban residential nature, perhaps at town centre or at sub-centres may be incorporated to broaden the diversity of dwelling circumstances with a community the size and innovative nature of North Pickering.

C. housing innovation in North Pickering should be a primary concern. The first step is to analyze the reasons, and the objective underlying innovation. Such innovation would be more at the micro-level of building and siting design concepts than at the micro-level of generalized housing types and density configurations which are the concern of this paper. Generally, such socially and physically sensitive housing design innovation belongs further along the continuum of community design which will be the concern of the Plan for Development.

A series of residential implementations exploring a wide range of design alternatives should be incorporated possibly on scattered key sites through North Pickering to encourage new thinking and action about housing.



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